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FOREST SERVICE

ANNUAL REPORT

1944

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION*

Berkeley, Calif.

M. W. TALBOT, Associate Director

Not for publication

*In cooperation with the University of California

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R-CAL
REPORTS
Station's annual

March 1945

ANNUAL REPORT OF THE

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION[1/]

1944

FOREWORD

Review of the record of this Station last year justifies three conclusions: first, forest and range research made a substantial contribution to war-supporting activities; second, an increasing demand for information during the past year reflects a widening appreciation of the vital role expected of research in furtherance of resource management; and third, wartime demands upon and weakening of the Branch of Research comprise a trend which should be reversed as speedily as war requirements permit, in order to get prepared in time for post-war responsibilities — and opportunities.

Wartime conditions have operated to create or aggravate the current problems of Research in three ways: by cuts in appropriations, which have prevented even temporary filling of important staff vacancies created by war; by loss of personnel to the armed forces and otherwise; and, concurrently, by increased demands for data and consultative services. Our remaining staff and facilities are inadequate for the three-way task of (1) supervising the war-assisting jobs which still make up the bulk of our program, (2) maintaining essentials of major pre-war projects, and (3) handling the many high priority jobs of reshaping existing research data into guides and manuals for use in practical forest management. The need of the administrative branch of the Forest Service and other land-managing agencies for some of this information is obviously urgent. It is unfortunate that Research should be thus handicapped just at a time when the demand for our wares was never greater.

Despite this temporary wartime curtailment the Station succeeded during the past year in adding substantially to the factual foundation for forest resource management. Submitted in the following pages is a brief

1/ In cooperation with the University of California

summary of important findings and progress during 1944, Division by Division, instead of the more complete and detailed pre-war type of report. In selecting highlights for inclusion the aim has been to stress results of real practical value and application. The screening test has been: Just what has this particular result done for land or just how can the findings be used to improve the management of forest and wild lands — and their crops of wood, water and forage? The more significant facts and trends of the year, thus selected, have been arranged by broad subject-matter sections. In parenthesis under the heading of each section will be noted the name of the staff member having chief responsibility for that section.

SURVEYS AND RESEARCH SERVICES FOR WAR AGENCIES
(George F. Burks, in charge)

The increasing demand for lumber in 1944 largely to meet military and essential civilian requirements led the War Production Board to declare it one of our most critical war items and to put into effect measures designed to more rigidly control its distribution. Lumber stocks had reached such a low level that only a very limited supply could be counted upon from this source. The main burden of supplying the demand therefore rested with the lumber producers. In order that all possible aid be given the mills to maintain maximum production under wartime difficulties it was necessary that the war agencies controlling the nation's output be currently advised of problems confronting the industry as they developed. To this end the Station continued its cooperative work primarily for the War Production Board, having as its major objective the conduct of fact-finding surveys relative to lumber production. To this task was devoted a considerable portion of our facilities and manpower.

Lumber production in California in 1943 reached an all-time high, being about 1 percent more than in the peak year of 1941 and about the same percentage more than the 1942 cut. Indications are that production in 1944 will slightly exceed the 1943 record with increases noted in both the pine and redwood regions. This is a remarkable industry achievement in view of the difficulties of operation centering mainly about manpower and equipment shortages. It is believed that information supplied by the Station has materially assisted the policy and action agencies and has thereby contributed in some measure to this production record.

Major Accomplishments

At quarterly intervals a comprehensive appraisal of the factors affecting lumber production for both the pine and redwood regions was prepared for the Lumber Branch of the War Production Board. These appraisals included estimates of production to date, a forecast of expected production, an analysis of manpower and equipment problems, weather, and other difficulties. The two fall reports were expanded to include a summary of log inventories for winter milling and in addition the final report for the year contained a summary of the winter operating plans of the pine-region mills. As conditions became more critical in the industry the

Lumber Division of the War Production Board called on the Station to report more frequently on factors affecting production which required immediate action to prevent loss in production. Examples: prospective mill closures under L-335, the shortage of heavy duty truck tires, and the inadequate supply of anti-freeze.

The 1943 census of lumber production, based on 100-percent canvass of the 378 mills in California, was conducted for the Bureau of the Census. This canvass obtained data by individual mills on lumber production and average selling price by timber species, days operated, lumber shipments by destination, lumber stocks, and purchases and sales of stumpage and logs. The production data were summarized by species and mill size classes separately for the pine and redwood regions and distributed as a Station research note to interested agencies and individuals throughout the country.

In cooperation with the California Redwood Association a statistical statement was prepared each month, covering lumber production in the redwood region by species and by size-class of mill. A similar statement on lumber inventories at the sawmills was prepared on a quarterly basis for the first three quarters and on a monthly basis thereafter.

In cooperation with the War Manpower Commission and the War Production Board the bi-monthly employment reports for all of the lumber companies reporting to the WMC were compiled and analyzed by mill size class and by type of operation. The summary gave number employed and additional needs, number of separations by cause, total hires and number hired through the U. S. Employment Service, and the monthly rate of turnover. These compilations served as a guide to the regional and district War Manpower Commission offices in applying its labor stabilization program to the lumber industry.

In addition to these periodic appraisals and surveys a number of special reports were prepared which provided information pertaining to a particular subject and needed at a specified time. Among these were —

1. A report of the truck movement of logs and lumber, based on current hauling practices, and the number of company-owned and contractor-owned trucks and trailers in use in logging and lumbering in California. The report provided statistics on the volume of logs and lumber transported daily by truck either all or part way to the final destination, the average distance hauled, and the proportion of total volume transported which moved by truck.

2. In cooperation with the California Redwood Association and the State USDA War Board, a summary of the number of internal combustion power units at sawmills and related operations and in the woods, and the number of crawler tractors separately by horsepower rating in use in the lumber industry throughout the State.

3. A compilation in October giving permanent type anti-freeze requirements for the winter of 1944-1945, the amounts used last year and the amounts obtained to date by logging and lumbering operations in the Pine Region.

4. A report on the fuelwood situation in California for the winter of 1944-1945 which included estimates of production and requirements in 1943 and 1944, the number of circular and drag saws used by farmers and the quantity of fuelwood used and sold by farmers, the quantity of fuels other than wood used by farmers, and an appraisal of the factors affecting fuel wood production.

5. A report on estimated production and consumer requirements for poles (communication and power) in California including a list of pole producers, distributors, and treating plants by type of treatment.

6. Investigations of a dozen applications for new logging equipment mainly in the redwood region and submission of individual reports appraising the need for such equipment.

Consultant and research services to war agencies and others in a position to further the war effort were of no less importance during the year both from the standpoint of accomplishment and of time and effort expended. Numerous requests for factual information were received from the local, regional, and district offices of the various war agencies interested in lumber production.

Plans for 1945

This work is expected to continue on about the same basis as in 1944, subject of course to such modifications as may be required by the War Production Board and other war agencies.

FOREST MANAGEMENT RESEARCH - PINE AND REDWOOD REGIONS
(Duncan Dunning, Chief of Division)

Main objectives of the Division of Forest Management Research are: (1) to develop harvest cutting practices that will arrest deterioration and convert some 9 million acres of pine and redwood old growth into thrifty productive stands; (2) to develop cultural methods for improving composition, quality and growth rates on one million acres of restocking cut-over and burned lands; (3) to work out economical means of reforesting some $3\frac{1}{2}$ million acres of cut-over and burned waste timber lands; (4) to determine the more important habitat factors and species characteristics concerned in tree growth to enable continuing improvements in cutting, cultural, and planting practices; and (5) to provide forest managers with tables and methods for scaling timber products, cruising forest lands, and estimating growth.

Efforts of the Division in 1944 followed three directions: Blacks Mountain harvest cutting in ponderosa pine — the single active project; services and cooperation in applying results of past research; and maintenance of long-term projects. Emphasis (60 percent of man months) was directed to the Blacks Mountain project because the timber produced is urgently needed and the insect control and cutting studies require long continuity of treatment and observation. Services applying research findings assumed increased importance as a result of acceleration in the timber business. Maintenance and formal reporting of long-term research projects, as during the last three or four years, fell below the level necessary to prevent loss of important values.

Cutting practices

General

Interest in better management of both private and public forest land was greatly intensified in California during 1944. This was evidenced by a policy statement from the State Board of Forestry; appointment of a State Legislative Committee to enquire into the status of California's forests (under direction of Senator G. M. Biggar); initiation of a redwood study by the Save-the-Redwoods League; initiation of the American Forestry Association's private land survey; and revival of interest in the U. S. Forest Service Survey. Interest was accelerated by the wartime shortage of lumber for civilian use and the war-enforced realization that few undeveloped logging chances remain available to mills cutting out.

Blacks Mountain pine management project.

Primary interest in this project centers in the 9,259,700 bd.ft. of ponderosa pine logs turned over to the Red River Lumber Company for conversion into war materials. Although this volume would be considered small in normal times, with the prevailing scarcity of labor and equipment, the daily output of 71,780 bd.ft. often assumed importance even to the large Westwood plant. The 1944 cut was 18 percent above that of 1943, mainly because weather permitted operating longer this season. The output per man-day, 2100 bd.ft., continued favorable as compared with private operations. All men of the crew, both logging and research, were over military age, classified 4-F, or recipients of medical discharges.

Cutting, because the insect threat was low, was directed mainly toward releasing young growth (1742 out of 1821 acres cut) removing from 3,128 to 7,611 bd.ft., to the acre, including all trees susceptible to beetle attacks.

Insect losses, as reported by the cooperating Bureau of Entomology and Plant Quarantine, continued at a low ebb — 20 bd.ft. to the acre in virgin timber and only $3\frac{1}{2}$ bd.ft. in stands where about 16 percent of the volume in susceptible trees had been removed by light sanitation-salvage cutting. Over the period of seven years since development of this method at Blacks Mountain, treated areas have shown loss rates consistently less than 20 percent of rates for untreated areas.

The seventh annual series of methods of cutting trials was established in 1944. Unfortunately lack of funds and technical personnel made it necessary to defer 5-year measurements due on the 1939 series.

A short-cut method of keeping logging costs was developed that is applicable to a wide range of cutting methods and makes detailed time studies unnecessary. From the daily out-put records for each man or crew, least squares regressions were prepared showing man-minutes required in felling, limbing, bucking, loading, and yarding by trees, logs, or loads.

The portable truck loader, designed and built on the project, continued to perform satisfactorily; hence a descriptive article with specifications was prepared for distribution to small logging operators.

Minor species. Abnormal wartime markets stimulated cutting of red and white fir resulting in requests for assistance in developing marking rules.

Cultural Methods

Training

Assistance was given R-5 in conducting a training conference June 5-17 for about 20 Forest staff men and rangers preliminary to inaugurating a program of timber cultural work. Procedures were developed for classifying timberland according to cultural needs, and standards were adopted for thinning, pruning, site treatment, and planting.

Blister Rust

Studies of sugar pine reproduction and growth have been used during the past several years by the Station to point out the necessity for close coordination of blister rust control and other management work to insure a pay-off in terms of sugar pine crop trees. Standards for control units need to be reexamined using new criteria for judging areas as to feasibility of management for sugar pine and for judging reproduction as to its crop tree potentialities. Approval of a control unit should be accompanied by a definite commitment to follow through with the special cutting, protection, and cultural measures required to get sugar pine into the stands or keep it there. Cutting, planting, thinning, and competition studies indicate that these special measures will be more expensive and uncertain of success than previously assumed. The train of management activities must be synchronized, all in the same place with none omitted, and on good accessible areas where sugar pine can be grown high enough in quality to command the necessary premium price. A conference of Blister Rust Control and Forest Service personnel considered these facts at Feather River Branch October 30-31 and recommended review of control and silvicultural standards.

Reforestation

Grading seed and planting stock

A comparison of field survival and growth of ponderosa and Jeffrey pine planting stock of three size grades from three seed sizes, begun in 1938 and reported to the end of 1943, showed that seed grading resulted in only small advantages of no practical consequence, but that discarding approximately the smallest third of the seedlings and about one-sixth of the transplants will greatly improve plantation success and reduce overall costs. The superior trees came from large transplants that were large seedlings, tending to support the Station's theory of pine silviculture — favor the dominants from seedling to sawlog.

Site preparation and sugar pine interplanting.

Brush cover of Chamaebatia and Ceanothus was removed mechanically in 1941 from 37 unstocked portions of high-site sale areas in advance of natural seed fall, seeding under screens, and planting 1-1 sugar pine stock. No natural seedlings resulted from a good seed fall because rodents ate the seeds. At the end of 3 years enough (about 40 percent) of the sugar pines from seeding and planting survived and grew well to indicate possibilities of success in restocking extensive brush-infested cut-over lands. Results of this study were highlighted in Research Note No. 41, Site Preparation as an Aid to Sugar Pine Regeneration, by H. A. Fowells.

Water absorption in relation to root pruning planting stock.

A study of water used by pruned and unpruned seedlings showed that ponderosa pine can endure the more extreme dry periods likely to occur on timber sites, even when soil moisture falls below the conventional wilting point. Plantation mortality often is attributable not so much to severe climate as to impaired absorption of available water by pruned roots and to slow root regeneration.

Cork Oak

In the field test planting phase of this cooperative project, seeding and planting trials with varying degrees of tending in several California localities promise reasonably good survival and growth at the end of the second year.

Species Characteristics and Site Factors

All silvical studies were temporarily discontinued with the exception of such routine weather observations as could be maintained by field station caretakers.

Tables and Timber Measurement

The active timber market and shortages of labor renewed interest in simplified methods of scaling and cruising.

The possibilities of estimating the scale of logs by sampling were examined and found to be generally unpromising in this region. The suggestion was made that savings might be accomplished by scaling the gross instead of the net volume of each log, reducing gross totals to net volume by applying cull factors obtained through sampling. Inexperienced employees with brief training could scale gross volume and time would be saved through omission of individual log cull deductions. The few highly skilled experienced scalers would thus be freed for determining cull factors and for check-scaling.

War conditions increased the tendency to use tree estimates instead of log scale in selling timber. Under favorable conditions and with proper sampling controls this method could be used with considerable success. Unfortunately the procedure usually is resorted to for small sales or without adequate sampling in check-scaling. Owing to the normal variation in tree volumes, large departures from scale are common. The human propensity for "keeping peace in the family" is apt to result in constant loss to the seller. Efforts to reduce errors usually are expressed in demands for more accurate volume tables. Although in the case of some tables revision would be helpful, greatest improvement in the accuracy of tree estimates is to be sought in better sampling procedure. In the case of small sales, adequate sampling safeguards are likely to cost more than scaling. In large sales where tree estimating merits serious consideration, operating conditions and the variable nature of California timber increase the expense and limit practicability of accurate sampling.

The urge to speed up cruising and make use of inexperienced crews resulted in numerous requests for simplified diameter-class volume tables and height curves. Several more important tables were derived from records at hand for distribution as a Station "Research Note."

Increasing interest in forest management possibilities was manifested by several requests for material and advice on predicting growth and methods of conducting resource surveys.

Plans for 1945

The direction activities will take in 1945 is suggested briefly as follows:

1. Continue the Blacks Mountain ponderosa pine cutting, logging, and insect control experiments.

2. Prepare revised growth estimates for California as a section of the U. S. Forest Service Survey.

3. Continue analysis of accumulated records as a basis for revision of marking and cutting practices and post-war forestry programs.

FOREST GENETICS
(W. P. Stockwell, Chief of Division)

The long-range objectives of the genetics division remain unchanged. They are to breed and select more vigorous or better quality tree strains for recognized timber sites, and trees that will grow on sites from which they are now excluded by brush or other adverse site factors.

In addition to these major functions the Genetics Division stands ready to supply information or undertake studies to help in the solution of silvicultural problems that have their roots in the inheritance by trees of good or bad characteristics.

During the early period of the war most of the genetics projects were carried at a maintenance level, almost three-fourths of the division effort being devoted to such wartime assignments as the analysis of native plants for rubber, quinine, rotenone, tannin and fiber; the stimulation of gum turpentine flow; the analysis of plants for camouflage use by infra-red photography; other camouflage assignments; research with cork oak; teaching war geography to army personnel, etc.

While some of these or other wartime assignments continue, it has been possible during 1944 to re-direct more of the staff effort back to genetic problems. Especial emphasis has been placed on hybridizing.

The hybrids between Coulter and Jeffrey pines are sturdy, well formed trees that have grown, to date, more rapidly than any timber trees in the Jeffrey pine regions.

Perhaps the most promising result of the hybridizing program is the indication that hybrids which grow faster than either parent may be expected in considerable numbers. Of the 17 hybrid populations resulting from the work done at the Institute of Forest Genetics, three grow more rapidly than either of the parents.

This phenomenon, called heterosis, in which the hybrid offspring exceed either parent in growth rate, is known in other plant groups, but is very infrequent. Plant breeders use it in the production of high yielding corn, cotton and certain other crops. That 3 out of 17, or 17 percent of the successful pine crosses should exhibit heterosis is indeed promising of future successes in timber tree breeding.

In support of the breeding work, methods have been developed for rooting cuttings and grafting portions of one pine on another. These techniques aid in preserving unusual trees or propagating many identical trees for breeding purposes.

New plantation information was reported in the Journal of Forestry, in June, Watering Plantation Trees, by R. H. Weidman and C. R. Berriman.

Oleoresin analysis aids in detecting the various strains and hybrids used in the work. In addition, chemical substances, of possible

value, not hitherto known to be present in the species examined, have been found, for example, analysis of the oleoresin of Coulter pine has disclosed the presence of normal undecane, an unsuspected paraffin hydrocarbon.

Finally, studies of insect attacks on native and introduced trees have given information that aids in insect control on the breeding trees of the Eddy Arboretum and may, in the future, prove to be of value in the forest.

The present needs of the tree-breeding program are to pick up loose ends of earlier experiments that have lapsed for several wartime years; to write up accumulated data and findings; and to restore balance to the program by advancing those phases of the work that have fallen behind actual pollination, but on which successful breeding depends in no small measure.

Looking toward the post-war future several needs are apparent, if the breeding program is to progress most effectively. Because of the lag in time between undertaking genetic studies and their completion, they should be initiated as soon as possible if results are to be available during the critical post-war readjustment period. On the basis of these future needs four parts of the program should be emphasized:

1. Intensifying the systematic testing of the pines to determine which pairs of species will hybridize and the character of the hybrids.

2. Keeping up to date studies of cell structure and vegetative characters needed in selecting hybrids.

3. Continuation, and if possible intensification, of physiological studies, including oleoresin analysis, vegetative propagation and physiological response of trees under varied conditions.

4. Undertaking of preliminary work in field testing of promising strains or hybrids.

CORK OAK

(W. P. Stockwell, in charge)

The U. S. Forest Service cork oak program has been limited, to date, to small-scale preliminary testing and to collection of information on where, how and at what cost cork oak can be grown in the United States.

Test areas have been established in the Southern States, the Southwestern States and in California. A report of this work has been drafted but will be held up until after the spring inspection of 1945 before being completed so that the latest information can be included.

It is planned to test the adaptability of cork to other areas and conditions this year. Brushfield tests should be included because cork oak is a brushfield species in parts of the Mediterranean Region and may succeed under similar conditions in this country. If successful in brushfields, cork oak would be of great value, particularly in the West.

FOREST FIRE PROTECTION
(C. C. Buck, Chief of Division)

With its staff reduced to two men the Fire Division shifted primary emphasis in 1944 from the established projects contributing to the basic long-term research program to extension and training activities and to assistance to the Region in solving immediate pressing fire problems. By following this course the Station and Region both felt that more could be contributed this year toward better fire control practice than by attempting to carry on the regular research program. The Shasta Branch Station was therefore closed as an active research center, and fire behavior research was limited to laboratory studies of fire ignition and spread by CPS personnel at San Dimas. Other going work was set aside.

Two major activities were scheduled for the year. The first had as its objective securing uniformly better administration of protection through more intensive application of established fire-danger-rating procedures to the administration and supervision of fire-control activities. The second was aimed toward development of a uniform system for appraising damages from fire on the four southern California watershed forests. The immediate purpose of this long needed project is to establish a sound basis upon which to determine the damages that would result from fire in a given drainage. Later it will be used in establishing justifiable levels of protection for areas primarily valuable for watershed purposes and in determining the best distribution of available protection resources between local administrative units.

Major Accomplishments

The primary purpose of rating fire danger on California national forests is to provide administrative officers with a guide to the strength of initial-attack fire-standby forces required from day to day to maintain adequate protection at all times without the excessive cost of overmanning on the less difficult days. To satisfy this purpose, however, measurements of the factors affecting danger must be made regularly and accurately, and the index of danger determined from these factors must be interpreted and applied in correct ways by administrative officers in their daily management and direction of the protection organization. A major part of the year was devoted to field inspection and training in this field. On nine national forests all danger-rating stations were inspected, instructions were given for bringing each up to standard, observers were instructed in proper procedures, and fire-control personnel from fire-control assistants to fire-control staff officers were shown how to interpret and apply danger measurements to administration of protection activities on their respective units.

Preliminary study of the fire-damage-appraisal problem was undertaken during mid-summer. It indicated very strongly that any fundamentally sound damage-appraisal system must consider the hydrologic and erosion characteristics of individual drainage units and the values pertinent to each that are susceptible to damage. To carry out the necessary operations in development of the appraisal system on this basis the work program was set up as a joint undertaking of the Fire and Influences divisions and of the forests concerned. By the close of the year detailed procedures for the hydrologic analyses had been set up, the pattern for compilation of values had been established, and the collecting and summarizing of field data were under way.

The division contributed approximately two man months to fire suppression during the year, assisting in suppression of several large fires throughout the Region.

Projects Suspended

Reorientation of the work program to accomplish the 1944 objectives, and loss of manpower, necessitated suspension of all work on a number of formerly active projects. Among these were:

1. Analyses of fire report data used in establishing current working objectives for region-wide application in fire-control practice.

2. Study of ways to secure more effective use of manpower and equipment resources in the suppression of large fires.

3. Study of regional and local detection problems including those to provide better measures of lookout efficiency during periods of reduced visibility and those aimed at securing better detection service from the local populace.

4. Studies of the use of herbicides in maintaining bare soil conditions along firebreaks and rights-of-way.

5. Study of the use of water and chemicals in fire suppression.

6. Studies of the relationship of weather elements measured in the open to those that affect the ways fires burn in forest stands.

7. Field studies of fire behavior.

Plans for 1945

Completion of the fire-damage-appraisal project by early spring is of first priority in the fire research program for 1945. Following completion of this work, and limited by the seriously undermanned staff, it is planned:

1. To resume the fire danger training and inspection program two-thirds completed in 1944.

2. To resume the study of the climate in and adjacent to forest stands.

3. To resume active study in the fire-behavior field.

4. To continue the program of direct assistance to the Region in solution of problems listed in the 1943 report.

RANGE RESEARCH

The purpose of range research is to analyze range problems and to aid in their solution. The latter requires development of desirable management practices and, equally important, methods of measuring changes in production and condition of ranges as practical guides for management. To obtain the greatest production of meat, hides, wool, and other products from both livestock and game animals without impairing future production or the site quality of the land, information is needed on numerous phases of practical management. Among these are proper intensity and season of grazing, methods of artificial reseeding, brush removal, erosion control, water spreading, and similar practices for a large variety of forage types in California, from the high mountains to the lower foothills and valleys.

Range investigations during 1944 were again centered on perennial-type summer ranges in the mountains of northeastern California at the Burgess Spring Experimental Range, and on annual-type ranges in the foothills of the San Joaquin Valley at the San Joaquin Experimental Range.

Major Accomplishments

Mountain Ranges (A. L. Hormay, Project Leader)

The main aims of Research on mountain ranges in 1944 were:

1. To obtain information on the comparative grazing values of cut-over pine-timber and meadow forage types for cattle.

2. To continue investigations of artificial reseeding of bitterbrush.

3. To extend technical advice and training to range examiners of the Agricultural Adjustment Administration on methods of judging range utilization and range condition.

4. To complete preliminary plans and estimates of range research contemplated for the post-war period.

Three specific studies have yielded significant highlights.

1. Grazing value of cut-over pine timberland for cattle — Forage goes to waste each season on extensive areas of cut-over pine

timberland on cattle ranges in northeastern California, while adjoining meadow and sagebrush types are closely grazed and in many instances seriously eroded and reduced in grazing capacity. This uneven grazing of adjoining types arises chiefly from the lack of adequate fences and watering places for controlling cattle grazing. Four years of records at the Burgess Spring Experimental Range, show that cut-over pine timber range furnishes excellent forage for cattle and should be utilized more efficiently. In fact, records indicate that pine-timber forage was slightly superior to meadow forage during 1944, in producing weight gains in cattle.

Specifically these studies showed that during the usual grazing season from June to September cattle gained approximately 190 pounds per head or 1.9 pounds per head per day on cut-over pine timberland forage. Most rapid gains were made when the forage was green, the maximum occurring during the flowering period. Weight gains started with the development of flower stalks of the important forage plants — about May 15 in the average year — and weight losses began in mid-September, approximately 6 weeks after seed maturity, when the forage was about 80 percent dry. For weight gains, a desirable season of grazing of cut-over pine timberland is from May 15 to September 15.

The eight most important forage species on the area studied were Idaho fescue, lupine, bitterbrush, squirreltail, cheatgrass, sedge, mountain brome, and Wyethia. Continuous grazing year after year, even though light, apparently will deplete the range of palatable forage species that occur in small quantities in the stand. To maintain these species, which in the aggregate contribute materially to high grazing capacity, some type of deferred and rotation grazing is necessary. The work is providing a basis for making needed adjustments in management of pine-timber and adjoining range types in eastern California and eastern Oregon.

2. Utilization of browse — A previously developed method of measuring utilization of bitterbrush opened a field of investigation which is important to both livestock and big-game management. The method was employed in a survey of forage conditions on a deer-problem area on the Modoc National Forest and is reported in, "The Winter Range of the Interstate Deer Herd" by G. A. Fischer, J. C. Davis, F. Iverson, and F. P. Cronemiller, Forest Service, Region 5. Research assisted in planning the study and compiling and analyzing the bitterbrush portion of the data.

3. Artificial reseeding of bitterbrush — The results of a laboratory study of the germination of bitterbrush seed carried on during the year, were used to develop methods of reseeding bitterbrush on the range. Germination and planting techniques worked out to date are being subjected to "proving ground" tests on various national forests in Region 5 in anticipation of a widespread bitterbrush reseeding program after the war.

Foothill Ranges (J. R. Bentley, Project Leader)

In 1935 systematic experiments were started at the San Joaquin Experimental Range to determine the most efficient way to utilize and maintain annual-type ranges, which are most valuable for grazing in winter and spring. These experiments were conducted cooperatively with the University of California, the animal-husbandry phases being handled by the University and the forage and soil phases by this Station. The main initial object of the forage and soils work was to determine the effect of intensity of grazing (stocking rate) on range condition and on forage production. Among others, studies of artificial reseeding, aimed at improving the quality and quantity of range forage, were also carried on.

Intensity of grazing. During the past year most of the available time was devoted to continuing essential records of the intensity-of-grazing experiments and to compiling and analyzing data collected since 1935, for publication. Recently completed analyses of data have substantiated earlier conclusions that moderate grazing of annual type range is better than either lighter or heavier grazing. Measurements of forage yield showed that continuous close grazing over a period of years reduced total forage production. Moderate grazing favors early winter growth of forage and affords protection to the soil which insures maintenance of forage yield.

In terms of livestock production also, as reported by the animal husbandmen, moderate grazing was more efficient than close or light grazing. Although close grazing yielded the greatest production of meat per acre, the lower gains and poor vigor of the cows were reflected in a reduced calf crop and low weaning weights of calves. Moderate grazing, to assure an adequate supply of range forage during all except the worst drought periods, is an important part of any range management program.

Some of the highlights of results of various grazing studies by the Range staff were published during the year in U.S.D.A. leaflet No. 239, "Moderate Grazing Pays on California Annual-Type Ranges," by A. L. Hormay. Except for minor changes in supplemental feeding the regular animal husbandry program of the University of California was continued. Major findings were reported in University of California Bulletin 688 "The Importance of Continuous Growth in Beef Cattle," by H. R. Guilbert, G. H. Hart, Kenneth Wagnon, and Harold Goss. In addition several popular articles were released through the agricultural press.

Artificial reseeding. Several promising forage species were tested in field plantings and the effect of time and depth of planting on seedling germination and survival was also studied. Most of the artificial reseeding trials carried out were necessarily on an exploratory, small-scale basis. Best survival was obtained with Harding grass, followed by weeping love grass, giant panic, Stipa cernue, S. pulchra, Elymus glaucus and crested wheatgrass.

Fertilizer applications produced little response in seedling growth except on wet swale areas. Repeat tests will be required to

determine the extent to which these results were due to the dry season. The possibilities of increasing forage production fully warrant strengthening of this phase of the range research program.

Plans for 1945

Research at the Burgess Spring Experimental Range on the value of timber-type and meadow forage and on artificial reseeding of bitterbrush will be continued in 1945, if wartime conditions permit, with highest emphasis on preparation of the essential findings for publication.

A searching analysis will be made of all data collected at the San Joaquin Experimental Range during the first ten-year period. Significant findings will be released in popular and technical publications. Following this thorough digest of existing information plans will be prepared for the direction of future effort.

All field work will be continued on a maintenance basis. Particular attention will be given to further measurement of the effect of intensity of grazing on forage yield by means of clipped plots. Field plantings of the most promising reseeding species will be made, at least on a small scale, to determine the effect of time of planting, method of cultivation, mowing, grazing and fertilizing on survival of first year stands. There is a rapidly growing need for this information to guide post-war reseeding — both public and private.

FOREST INFLUENCES
(C. J. Kraebel, Chief of Division)

Work of the division during the year was centered largely on the San Dimas Experimental Forest where assistance was available from the Glendora Civilian Public Service Camp. Emphasis there was placed upon the following phases of activity:

1. Compiling and analyzing data and preparing material for publication.

2. Collecting records from field installations especially those where continuity is essential such as precipitation, streamflow, erosion, climatic data from key stations, and records from lysimeters and runoff plots.

3. Carrying forward important integral studies to improve the accuracy of rainfall and streamflow measurements, to forge connecting links in the water cycle by determining interception losses and through soil moisture sampling, and to complete field inventories of soil, geology, and vegetation on the Experimental Forest.

Late in the year the division joined in a cooperative project with the Fire Studies Division and Region 5 in a fire damage appraisal study on the four national forests in southern California. The hydrologic

aspects of this project necessitated a reorientation of regular work. The analysis of some Influences data is being retarded while this study is in progress, but records from the San Dimas Forest are being maintained.

Significant findings

Rainfall measurement. Previous studies on the San Dimas Forest have shown that rain gages tilted normal to the slope give the best measure of rainfall on mountain areas. Analysis of these results and their application to 10 years of records from vertical gages in one watershed of the San Dimas Forest indicate that the actual rainfall was 10 percent greater than that measured by the standard gages. This shows the importance of properly exposing rain gages on mountain watersheds where accurate precipitation records are needed as basic information for improved land management.

Annual cycles of soil moisture. Analysis of the results of three years of periodic soil moisture sampling on the San Dimas Forest has shown that field capacity and wilting point define quite well the limits of soil-water storage at the several sites studied. When sufficient rainfall occurred, soil-water storage reached its field capacity; but regardless of rainfall the minimum summer storage was closely approximated by the wilting point. Annual evapo-transpiration losses under brush cover in high rainfall years averaged 18 inches, which was not much different than losses from bare soil. Information of this nature pertaining to the storage of water in the soil and its withdrawal are of real significance in the management of mountain lands, particularly from the standpoint of water yield in relation to the vegetation on the area.

Projects completed and reported upon

The analysis of data from the vectopluviometer or directional rain gage was completed. This study has disclosed much valuable information hitherto unknown concerning the behavior of storms and the general characteristics of rainfall.

Analysis of the results of a completed laboratory study of lysimeter drainage under controlled soil moisture tension, and of preliminary results from a comparable study in four lysimeters, indicates that the seepage rate and the excess moisture in lysimeters can be controlled by applying tension to the soil moisture at the base of the confined soil. There still remains the problem of devising a practical method of applying this finding to the working lysimeters in such a way that their drainage can be made comparable to that of unconfined soils on a mountain slope.

Remaining field work for the geologic survey of the San Dimas Forest was completed and office reports covering portions of this project were prepared.

Progress on uncompleted projects

An analysis of three years' data on precipitation, interception

and stemflow in the woodland-chaparral type was completed. Results show that interception losses by direct evaporation of precipitation from vegetation were about 5 percent of the total precipitation and less than 3 percent of the effective precipitation.

At the request of the watershed management section of the San Francisco Regional Office of the Forest Service, this Division assisted in setting up specifications for a cooperative soil survey of forest lands, conducted by the Division of Soils, University of California, on the Stonyford Ranger District of the Mendocino National Forest. This trial survey was aimed at the development of standard methods for post-war soil surveys of forest and other wild lands which will meet the essential needs of agencies responsible for the management of such lands.

In the fire-damage appraisal of the four southern California forests, the Division of Forest Influences has cooperated with the Division of Fire Studies in the hydrologic phases of the work by contributing to: (1) development of methods of analysis for determining and predicting the effect of fire on flood runoff, streamflow, and erosion; (2) assembly and compilation of data concerning the hydrology, vegetation, soil, and geology of the watersheds; and (3) the analysis and interpretation of these data as they relate to fire history.

An outline of hydrologic analysis was developed for interpreting results of watershed and streamflow studies on the San Dimas Experimental Forest. The outline will be useful also in establishing priorities of work in the hydrologic phases of forest influences research, and in the analysis of essential data for flood control surveys and watershed management plans in the post-war period.

Field work for the vegetation cover type map of the San Dimas Forest watersheds was completed, including a summary of vegetation type areas for each watershed.

The experiments in establishing various species of vegetation on the San Dimas lysimeters were continued. In general it was found essential to eliminate or definitely restrict the present grass cover when the plantings are made. Stock was grown and preparations were made for planting of approximately half of the "buffer" area surrounding the lysimeters. For this purpose a small nursery was established at Tanbark Flat, an innovation necessitated by the wartime closing of the Devil Canyon Branch Station.

The following studies of soils and soil moisture relations on the San Dimas Experimental Forest were continued:

1. Determinations of soil-moisture in the large San Dimas lysimeters by periodic sampling to reveal the effect of some volunteer summer growing plants among the annual grasses now growing in the tanks.

2. The soil survey of one key watershed, including completion of 3,024 laboratory analyses.

3. The soil-moisture study of the same watershed. (Preliminary results show some large differences between sites but in general indicate that the average depth of active evapo-transpiration is about 12 inches.)

4. Development of an electrical soil-moisture measuring instrument was continued. (Overcoming during the year of a previous difficulty paved the way for early field tests of the improved model.)

Projects Suspended or on Maintenance Level

Installations on the Big Creek watersheds at the Kings River Branch and those at the North Fork and Bass Lake work centers were operated on a maintenance basis with the collection of only the most essential records made possible by assistance from the Sierra Forest and the North Fork CPS Camp.

Devil Canyon Branch Station remained closed. No further records were taken on the Teakettle Creek watersheds at the Kings River Branch or from the Berkeley installations. Soil stabilization studies involving the revegetation of burned or barren watersheds and road slope fixation methods remained in suspended status, except for occasional observations of old treated areas incidental to other work.

Plans for 1945

The loss of staff members now in military service or transferred to high priority war projects, has thrust an increasing burden on the remainder of the staff. As in other Divisions of the Station, this has retarded the analysis of data, has caused the suspension of important phases of work and has reduced several projects to a maintenance basis as noted.

The major effort of the division during the current year is being placed on the following activities:

1. Completing of the hydrologic aspects of the fire-damage appraisal study in southern California.

2. Moving into publication several manuscripts now in various stages of completion.

3. Continuing the analysis of accumulated data from the San Dimas Forest and the North Fork Bass Lake installations. In this work, first priority will be given to the analysis and subsequent publication of data most needed and expected to have greatest usefulness (1) in post-war flood control and watershed management projects, and (2) in keeping the division's efforts directed most efficiently at the major watershed problems.

4. Maintaining the continuity of hydrologic records and studies in progress on the San Dimas Forest at the present level.

5. Continuing if possible the collection of minimum records from the North Fork and Bass Lake work centers and the Big Creek watersheds at Kings River Branch.

6. Cooperating with the San Francisco Regional Office of the Forest Service in developing plans for post-war execution of surveys, inventories and action programs in the field of watershed management, with particular emphasis on the Los Angeles River flood-control project.

FOREST PRODUCTS
(H. Garland, in Charge)

Reorientation of effort and emphasis in this division imposed by wartime conditions in 1943 continued during 1944. The time of the single staff member was obligated to the Requirements, Production and Supplies project to the extent required to carry out the War Production Board assignments. Because of the demands of the RPS project no Forest Products research studies were carried through to the point of formal reporting. Nor was it possible to resume active work on the regular research program of the logging and milling project of the division.

Major Accomplishments

The greater portion of the time remaining between RPS jobs was used in supplying information on forest products problems by letter, telephone and conference. This involved identification of woods, advice on species substitution, sources of wood, uses of species, seasoning practice, etc. Several inquiries led to a considerable amount of study, such as, the possibility of obtaining official recognition of ponderosa pine as a piling wood, the use of fiber board as a substitute for wood in fruit containers, the treatment of vegetable dehydrator trays, a new method of treating fence posts, and the possibilities of pulp and paper production in California.

An informal study was made of small sawmill methods with staff members of the Forest Products Laboratory of Madison, Wisconsin.

The Division participated actively in post-war planning, both for the Departmental Plan and for the Division of Research.

Plans for 1945

The need for study of the problems of efficient utilization of pine second-growth stands has been accentuated by the war demands for all kinds of forest products. The small mill, which has always been a problem child, has been given a running start at the cutting of second-growth stands, and it appears that the scarcity of old-growth stands that may now be foreseen will sustain this movement. Delay of another year or two in attacking the utilization problems of second-growth pine may reduce significantly the effectiveness of the research. A second-growth mill study, the analysis of which has been deferred, should be completed

as soon as possible. A study of the suitability of California species for poles and piling should be made now while they are being used as war substitutes.

The shortage of eastern hardwood lumber has caused some demand for California hardwoods and this situation presents an unusual opportunity to investigate these woods and promote a permanent place for them in the market. It would be unfortunate if we should have to continue to withhold action when cooperators are available. The problems of white fir utilization should be attacked now while this timber species is enjoying wide acceptance in the war lumber market.

The division should be able to follow through on its plans for a survey of waste wood in California as part of the Forest Service reappraisal of the timber-situation. Detailed information of this kind will be needed at the immediate beginning of the post-war period in order to catch the war-born enthusiasm for wood utilization.

Effective attack on some of these needed studies will require the establishment of a full fledged Forest Products Utilization Unit of three or four technicians.

POST-WAR PLANNING

The Station continued as an active participant in completion of the interagency departmental post-war planning report and in other activities of that departmental committee.

FOREST SURVEY

(A. E. Wieslander, Chief of Division)

The approved Survey program for the fiscal year 1945 comprises four jobs as follows:

1. Report on California timber supply situation.

2. Region 5 training course in aerial-photo interpretation.

3. Yuba County survey in cooperation with the State Board of Equalization.

4. Developing survey techniques and completing work plan for post-war Forest Survey.

Job No. 1 comprises a quick survey to provide a fairly complete though preliminary picture of California timber supply situation. Beginning as a joint undertaking of the California Region of the Forest Service and the Experiment Station under Station leadership, it has developed into a three way cooperative project of the American Forestry Association, the California Department of Natural Resources, and the U. S. Forest Service. In addition the Save-the-Redwoods League is cooperating insofar as the

redwood region is concerned. As a consequence of this mutually beneficial cooperation, duplication of effort was obviated and the basic figures being obtained on areas, volumes, growth, drain and requirements will be official for all concerned. Under the plan being followed timber-stand conditions are being classified from aerial photographs. Volume estimates are being obtained by applying to the acreages of these classifications, the stand-per-acre figures from existing available cruises that are used as samples.

The second programmed job of the division, the aerial-photo-interpretation course, marked a big step forward in techniques of resource management.

Plans for 1945

The joint Region-Station analysis of the California timber situation, well under way in 1944 as just indicated, will be merged into the nation-wide timber reappraisal project.

At the request of Region 5, the administrative branch of the Forest Service in California, another air-photo-interpretation course was scheduled for an advanced fire-control group of the Region.

Undertaking of the third major job, the cooperative Yuba County survey, must necessarily be postponed until completion of the reappraisal project. The purpose of this county survey is to determine the utility of aerial-photo classification of vegetation types and forest stands in the assessment of forest and range lands.

The fourth job also, that of developing survey techniques using aerial photographs and completing the post-war work plan for the Forest Survey must — and much to our concern — be temporarily shoved aside until completion of the reappraisal job. However, the state-wide report on the timber situation with its area and volume statistics should afford a good basis for defining objectives of future Survey work in California. Also, the Yuba County survey is really an important step in developing survey techniques and intensity of sampling. It is imperative that this vital core of our Survey work be resumed and facilitated at the earliest possible date.

COOPERATING AGENCIES

During 1944 our work continued to be even more closely tied in with the Administrative program of Region 5 which strengthened and assisted in many ways our research program as a whole as well as many of the specific projects here reported upon. Without this splendid cooperation during another wartime year more serious curtailment of high-stake Forest Service research projects would have been unavoidable.

The high importance of the valued tie with the University of California, our primary research cooperator, as detailed in our 1943 report,

was reflected in close working relations with a dozen departments and divisions of the University and all of our divisions.

Cooperative studies of the Bureau of Entomology and Plant Quarantine, Department of Agriculture, were continued. These studies are vital to the solution of several forest management problems, especially those at our Blacks Mountain Branch Stations. Project details will appear in the annual report of the above bureau.

Cooperation with various other agencies, Federal, State and community, was continued to the degree permitted by war conditions.

The Civilian Public Service Camps for conscientious objectors have given substantial assistance to our research programs at the San Dimas Experimental Forest, the Institute of Forest Genetics, the San Joaquin Experimental Range, and Kings River and Feather River Branch Stations, thereby making possible the maintenance of several important research projects which otherwise would have been more seriously curtailed or entirely closed.

STAFF PUBLICATIONS, 1944

Printed

Berriman, C. R. See Weidman.

Buchholz, J. T.
The cause of sterility in cross-pollination between certain species of pines. Paper presented at the annual meeting of the Botanical Society of America, September 12-14, 1944. Abstract in American Journal of Botany 31(8):22. October 1944
(At our request, Professor Buchholz, of the University of Illinois, initiated a series of studies on sterility barriers to hybridization in the laboratory of the Institute of Forest Genetics, with material furnished by us. The citation given above is the first paper to appear as a result of this work.)

Bruce, Herbert D.
Observations on the visibility of a small smoke. Journal of Forestry 42:426-434. June 1944.

Colman, E. A.
The dependence of field capacity upon the depth of wetting of field soils. Soil Science 58(1):43-50. July 1944.

Colman, E. A. (G. B. Bodman and E. A. Colman)
Moisture and energy conditions during downward entry of water into soils. Proceedings Soil Science Society of America 8:116-122. 1944.

Colman, E. A., and E. L. Hamilton
The San Dimas water-stage transmitter. Civil Engineering 14:257,258. June 1944.

Hamilton, E. L. See Colman.

Hormay, A. L.
Moderate grazing pays on California annual-type ranges. U.S.D.A. Leaflet No. 239. 8 pp. 1944.

Horton, Jerome S., and John T. Wright
The wood rat as an ecological factor in southern California watersheds. Ecology 25:341-351. July 1944.

Johnson, Paul B. A nomograph for the integration of stream-flow records. Civil Engineering 13:494-495. October 1943.

Johnson, Paul B. Instrument for measuring stream flow. Civil Engineering 14:523-524. December 1944. Discussion of "Velocity-head rod calibrated for measuring stream flow," by H. G. Wilm and H. C. Storey. Civil Engineering 14: 475-476. November 1944.

Kraebel, C. J., Kolbe, E. L., Munns, E. N., et al.
Survey report on Santa Ynez River watershed, California. (House Document No. 518, 78th Congress, 2d Session) 1944.

Mirov, N. T.
Experiments in rooting pines in California. Journal of Forestry 42:199-204. March 1944.

Mirov, N. T.
Possible relation of linolenic acid to the longevity and germination of pine seed. Nature London 154(3902):218, 219. August 12, 1944.

Rowe, P. B.
Discussion of "Role of land during flood periods," by W. W. Horner. Proceedings American Society of Civil Engineers 69:1616-1618. December 1943.

Rowe, P. B.
Discussion of "Soil-moisture records from burned and unburned plots in certain grazing areas of California," by F. J. Veihmeyer and C. N. Johnston. American Geophysical Union. Transactions, 1944, pt. I, p. 84-86. 1944.

Storey, H. C. (H. G. Wilm and H. C. Storey)
Velocity-head rod calibrated for measuring stream flow. Civil Engineering 14:475-476. November 1944.

Weidman, R. H., and C. R. Berriman
Watering plantation trees. Journal of Forestry 42:435-437. June 1944.

Mimeographed

California Forest and Range Experiment Station
Stumpage and log prices in California by species and type of sale. Preliminary statistics for 1943. 2 pp. Research Note No. 38. July 12, 1944.

California Forest and Range Experiment Station
Production of lumber, lath, and shingles in California, 1943. 5 pp. Research Note No. 39. November 15, 1944.

Fowells, H. A.
Site preparation as an aid to sugar pine regeneration. 4 pp. Research Note No. 41. December 27, 1944.

Gleason, Clark H.
Directions for sowing mustard for erosion control in burned areas of southern California. 29 pp. Research Note No. 37. January 15, 1944.

Kraebel, C. J. See Talbot.

Talbot, M. W., and C. J. Kraebel
Relation of forest lands to agriculture, industry, and people in southern California. 5 pp. Research Note No. 39. October 2, 1944.

The foregoing formal list reflects only in part the volume of paper work output of research results and assembled information during 1944. A large amount of additional information, summarized and interpreted, was supplied for activities of continuing and current importance. Specific examples are:

(1) RPS quarterly reports of factors affecting lumber production, estimates of quarterly production, forecasts for the year, etc., chiefly for the War Production Board — a total of 8 mimeographed reports averaging about 25 pages each;

(2) The processed Departmental post-war planning report for which material was prepared by all divisions of the Station.